SNS Ring Feedback Considerations

General requirements:

- Frequency range – 200 KHz (resistive wall instability) to 150 MHz (e-p instability)
- Gain – 0.1 to overcome e-p instability growth time (instability growth scales from 10 to100 μs at PSR in Los Alamos)

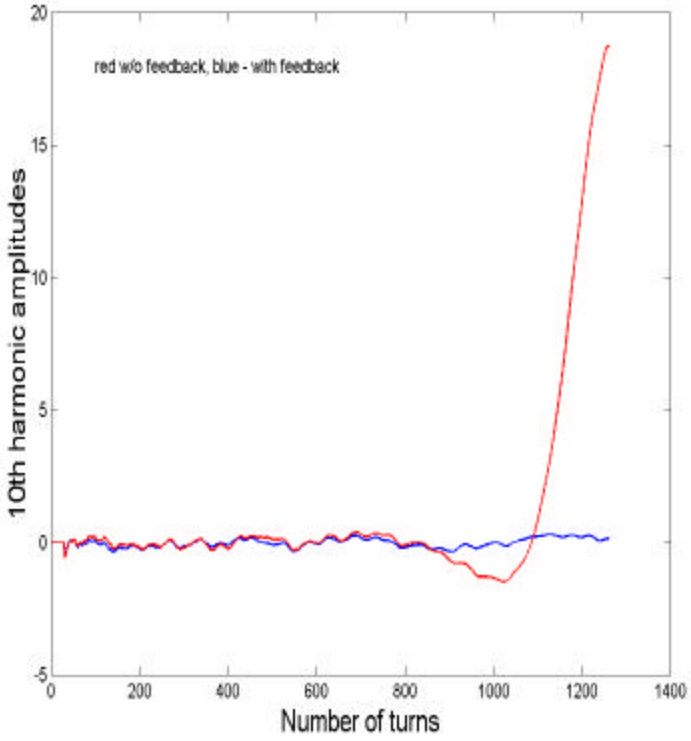
SNS Ring Instability Expectations

- E-p instability depends on how successful the TiN coating and solenoidal field work against secondary emission. Its frequency is about 150 MHz
- Extraction kicker impedance (measured) gives instability in simulation at 1.5 10^{14} protons – frequency range 5-12 MHz
- Resistive wall instability dangerous below integer resonance (Qy=5.8) – corresponding frequency 200 kHz, increment – about 200 turns

Suggested FeedBack

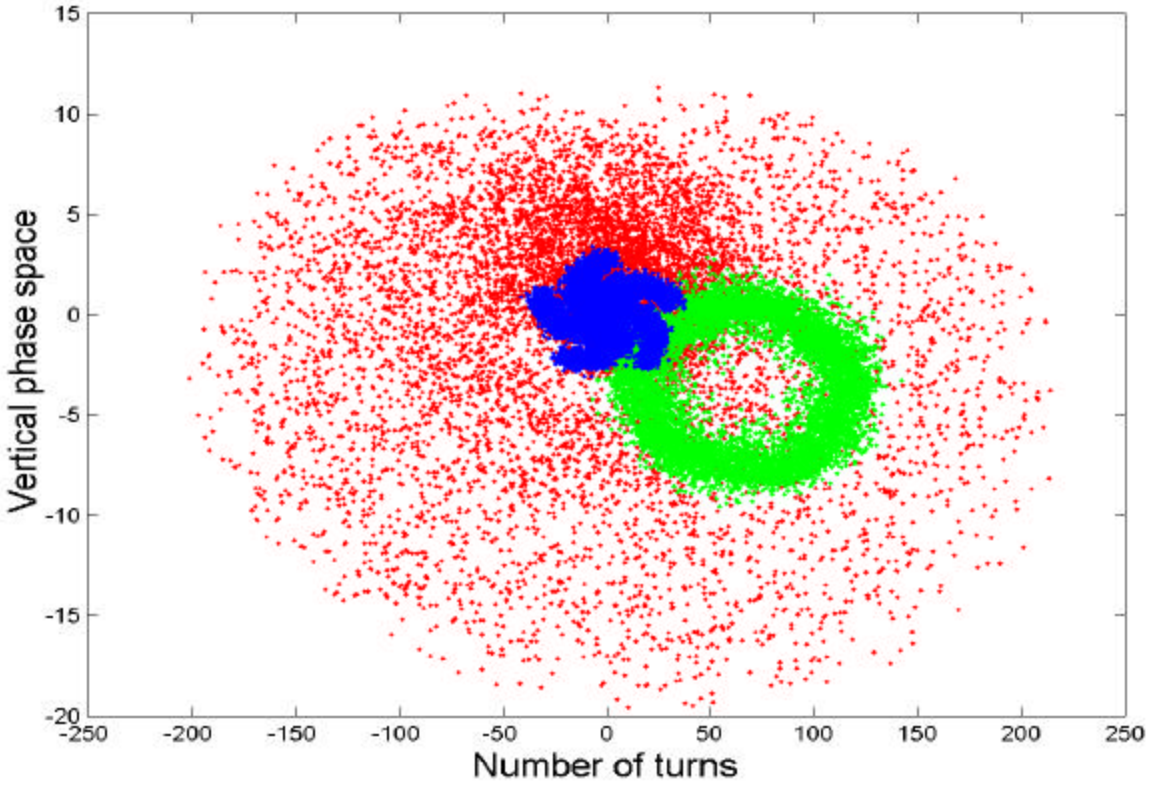
- Broadband resistive – 200 kHz to 200 MHz
- Gain 0.1 – preferably, for whole frequency range
- Kickers – 50 cm each (3 instead of one 2m kicker). We assume 50 Ohm terminated strip lines.
- 2 pickups. Flat response up to 300 MHz is ideal, low noise (less than equivalent 0.3 mm)
- Estimated power (PSR PU noise taken as an example – 1.5 kW if one 50 cm kicker). For our aperture noise can be 2 times higher – resulting power goes up to 6 kW.

FeedBack versus EK impedance instability



- ORBIT gets FeedBack module
- It has possibility to model resistive and reactive FB systems with arbitrary filters
- In resistive variant damps successfully all unstable harmonics for 2 MW beam (left: red is 10-th harmonic w/o, blue – with FB system). Gain 0.01

Vertical Phase Space



Summary and Future Work

- For EK impedance suggested FB works in simulation – g=0.015 and two turn Notch filter do the job
- Higher gains (g>0.1) need optimization of power but look feasible
- 3D space charge simulation need to be performed with the new feedback module
- Whether it helps or not against EP instability needs to be checked by simulation – the EP node needs to be developed in ORBIT.